

CLAIMS

1. A conveyance system (10) comprising:

a conveyance carriage assembly (12) for carrying a workpiece (1) thereon; and

conveyance units (16, 18) to which said conveyance carriage assembly (12) is conveyed;

wherein said conveyance carriage assembly (12) has driven members;

said conveyance units (16, 18) are separable into units; each of said units having:

a rail (28) for guiding said conveyance carriage assembly (12); and

a driver associated with said rail (28) for driving said conveyance carriage assembly (12) through said driven members; and

wherein when the last one of said driven members is separated from a movable range of said driver, at least the foremost one of said driven members is relayed to said driver of the unit adjacent thereto and said conveyance carriage assembly (12) is continuously conveyed.

2. A conveyance system according to claim 1, wherein each of said units includes:

two said rails (28); and

two said drivers associated respectively with two said rails;

wherein two said rails extend parallel to each other; and two said drivers convey said conveyance carriage assembly

(12) in opposite directions, respectively.

3. A conveyance system according to claim 2, wherein said units comprise three units including:

a horizontal conveyance unit (16) for linearly conveying said conveyance carriage assembly (12);

a gradient conveyance unit (18) for conveying said conveyance carriage assembly (12) on an upward grade and/or a downward grade; and

a direction changing unit (20) for changing a conveyance direction of said conveyance carriage assembly (12);

wherein a plurality of types of said units are combined with each other.

4. A conveyance system according to claim 1, wherein said driver comprises an annular chain (30) which is circulatingly drivable through a sprocket (36); and

said driven members comprise driven sprockets (246, 266c, 266d) held in mesh with said annular chain (30) or a presser plate (242) for pressing rollers (30a) of said annular chain (30).

5. A conveyance system according to claim 1, wherein said rail (28) is in the form of a plate which is elongate in a conveyance direction; and

said conveyance carriage assembly (12) moves laterally of said rail (28), and carries the workpiece (1) on a side of said rail (28).

6. A conveyance system according to claim 1, wherein said conveyance units (16, 18) include:

a plurality of horizontal conveyance units (16) for conveying said conveyance carriage assembly (12) in a substantially horizontal direction; and

a gradient conveyance unit (18) interconnecting two of said horizontal conveyance units (16);

wherein said gradient conveyance unit (18) comprises:

a gradient conveyance drive sprocket (170) disposed closely to an end of the gradient conveyance unit (18), said gradient conveyance drive sprocket (170) being rotatable by said driver;

a gradient conveyance driven sprocket (172) disposed closely to an opposite end of the gradient conveyance unit (18), said gradient conveyance driven sprocket (172) being rotatable;

a gradient conveyance annular chain (162) held in mesh with said gradient conveyance drive sprocket (170) and said gradient conveyance driven sprocket (172), said gradient conveyance annular chain (162) being circulatingly drivable; and

a gradient guide (176) for supporting, from below, an upper portion of said gradient conveyance annular chain (162) which imparts drive power to said conveyance carriage assembly (12) and a lower portion of said gradient conveyance annular chain (162) which is guided in a direction opposite to said upper portion, making said gradient conveyance annular chain (162) upwardly convex in shape;

wherein said conveyance carriage assembly (12) has a

gradient conveyance driven sprocket (246) positioned near a leading end of the conveyance carriage assembly (12) in a conveyance direction and held in mesh with said gradient conveyance annular chain (162); and

wherein after said conveyance carriage assembly (12) is pushed out from said horizontal conveyance unit (16), said driven sprocket (246) is brought into mesh with said gradient conveyance annular chain (162), and said conveyance carriage assembly (12) is conveyed by said gradient conveyance annular chain (162) along the shape of said gradient guide (176).

7. A conveyance system according to claim 6, wherein said conveyance carriage assembly (12) comprises at least two conveyance carriages interconnected longitudinally by a vertically swingable or elastically deformable joint (208).

8. A conveyance system according to claim 6, wherein each of said horizontal conveyance units (16) has:

a horizontal conveyance drive sprocket (36) disposed closely to an end of the horizontal conveyance unit (16), said horizontal conveyance drive sprocket (36) being rotatable by said driver;

a horizontal conveyance driven sprocket (38) disposed closely to an opposite end of the horizontal conveyance unit (16), said horizontal conveyance driven sprocket (38) being rotatable; and

a horizontal conveyance annular chain (30) held in mesh with said horizontal conveyance drive sprocket (36) and said horizontal conveyance driven sprocket (38), said horizontal

conveyance annular chain (30) being circulatingly drivable and being disposed in a position different from said gradient conveyance annular chain (162) in a transverse direction of said horizontal conveyance unit (16);

wherein said conveyance carriage assembly (12) has a push-out driven sprocket (266d) positioned closely to a rear end of the conveyance carriage assembly (12), said push-out driven sprocket (266d) being positioned above said horizontal conveyance annular chain (30) when no external force is applied thereto; and

wherein as said conveyance carriage assembly (12) moves, said driven sprocket (266d) is lowered into mesh with said horizontal conveyance annular chain (30) by a push-out cam plate (56) in said horizontal conveyance unit (16).

9. A conveyance system according to claim 8, wherein said driven sprocket (266d) is lowered by:

a force bearing member (270) for directly bearing a pressing force from said push-out cam plate (56); and

a resilient member (268) compressible in interlinked relation to said force bearing member (270).

10. A conveyance system according to claim 6, wherein said conveyance carriage assembly (12) has:

a lowering driven sprocket (266c) disposed closely to a rear end of the conveyance carriage assembly (12), said lowering driven sprocket (266c) being positioned above said gradient conveyance annular chain (162) when no external force is applied thereto;

wherein as said conveyance carriage assembly (12) moves, said driven sprocket (266c) is lowered into mesh with said gradient conveyance annular chain (162) by a lowering cam plate (180) disposed in a downgrade region of said gradient conveyance unit (18).

11. A conveyance system according to claim 10, wherein said driven sprocket (266c) is lowered by:

a force bearing member (270) for directly bearing a pressing force from said lowering cam plate (180); and

a resilient member (268) compressible in interlinked relation to said force bearing member (270).

12. A conveyance system according to claim 1, further comprising:

a drive gear (94) rotatable by a rotational drive source;

a first driven gear (72) held in mesh with said drive gear (94), said first driven gear (72) being rotatable by rotation transmitted from said drive gear (94);

a second driven gear (74) held in mesh with said drive gear (94), said second driven gear (74) being rotatable by rotation transmitted from said drive gear (94) in a direction opposite to said first driven gear (72);

a first rotational shaft (68) as a rotational shaft of said first driven gear (72);

a second rotational shaft (70) as a rotational shaft of said second driven gear (74);

a first circulative driver (30) for being circulatively drivable in response to rotation of said first rotational

shaft (68); and

a second circulative driver (33) for being circulatively drivable in a direction opposite to said first circulative driver (30) in response to rotation of said second rotational shaft (70);

wherein said conveyance carriage assembly (12) is conveyed by said first circulative driver (30) and/or said second circulative driver (33).

13. A conveyance system according to claim 12, wherein each of said drive gear (94), said first driven gear (72), and said second driven gear (74) comprises a bevel gear, and said first rotational shaft (68) and said second rotational shaft (70) are coaxial with each other and perpendicular to the axis of said drive gear (94).

14. A conveyance system according to claim 12, further comprising:

a first inner bearing (67a) by which an end of said first rotational shaft (68) is rotatably supported, and a second inner bearing (67b) by which an end of said second rotational shaft (70) is supported, said first inner bearing (67a) and said second inner bearing (67b) being disposed between said first driven gear (72) and said second driven gear (74); and

a first outer bearing (78) by which an end of said first rotational shaft (68) is rotatably supported, and a second outer bearing (78) by which an end of said second rotational shaft (70) is supported, said first outer bearing (78) and said second outer bearing (78) being disposed on sides of said

first driven gear (72) and said second driven gear (74) which are opposite to confronting faces thereof.

15. A conveyance system according to claim 12, wherein said first circulative driver (162) is driven by a first drive sprocket (36) mounted on said first rotational shaft (68);

said second circulative driver (162) is driven by a second drive sprocket (37) mounted on said second rotational shaft (70); and

said first circulative driver (162) and said second circulative driver (162) comprise annular chains (30), respectively, and are circulatingly drivable by rotatable driven sprockets (38).

16. A conveyance system according to claim 1, wherein said conveyance carriage assembly (12) has:

a retaining mechanism for retaining the workpiece (1);

a retaining member operating mechanism (86, 98, 100, 128a, 128b) for operating a retaining member of said retaining mechanism;

a resilient member (1092, 1134) for pressing said retaining member in a direction opposite to the direction in which said retaining member is operated by said retaining member operating mechanism (86, 98, 100, 128a, 128b);

a main body (1056) supporting said retaining mechanism and said retaining member operating mechanism (86, 98, 100, 128a, 128b); and

a roller (216, 218) mounted on said main body (1056) and engaging said rail (28);

wherein said retaining member operating mechanism (86, 98, 100, 128a, 128b) operates said retaining member through operation of a drive mechanism (1024) disposed closely to said rail (28), and is displaced while being guided along said rail (28).

17. A conveyance system according to claim 16, wherein said retaining mechanism comprises:

a clamp mechanism (1078a, 1078b) having a clamp (1096a, 1096b) operated by said retaining member operating mechanism; and

a holding mechanism (1080a, 1080b) having a set of plate members including at least one movable plate (1106, 1108), for holding a portion of said workpiece (1) which is different from the portion thereof which is gripped by said clamp mechanism (1078a, 1078b), with said set of plate members;

wherein said clamp (1096a, 1096b) and said movable plate (1106, 1108) are displaced by said retaining member operating mechanism to hold or release said workpiece (1).

18. A conveyance system according to claim 16, wherein an engaging member (1074) engageable by a hook (1038) of a first lock mechanism (1036) disposed closely to said rail (28) when said retaining member operating mechanism operates said retaining member through operation of said drive mechanism, is mounted on said main body (1056).

19. A conveyance system according to claim 16, further comprising:

a pocket (1076a, 1076b) for supporting an end of said workpiece (1) inserted therein.

20. A conveyance system according to claim 19, wherein said pocket (1076a, 1076b), said clamp mechanism, and said holding mechanism (1080a, 1080b) are mounted on said main body successively upwardly in the order named, and an elongate member as said workpiece (1) is conveyed in an upstanding state.

21. A conveyance system according to claim 20, wherein the elongate member as said workpiece (1) comprises a connecting rod for an internal combustion engine.

22. A conveyance system according to claim 1, further comprising:

a conveyance carriage assembly stopping mechanism (2010) for stopping the conveyance carriage assembly (12) for carrying and conveying the workpiece (1);

said conveyance carriage assembly stopping mechanism (2010) comprising:

a stopping engaging member (232) mounted on said conveyance carriage assembly (12);

a first arm (2100) and a second arm (2102) which extend in a conveyance direction of said conveyance carriage assembly (12) and have respective shanks having pivotally supported ends;

a displacing mechanism (2106) for displacing said first arm (2100) and said second arm (2102) toward and away from

each other; and

an entry path (2110) defined between said first arm (2100) and said second arm (2102) for said stopping engaging member (232) to enter, said entry path (2110) having a narrower portion (2126) having a width which is progressively smaller in a direction of travel of said stopping engaging member (232), and a wider portion (2128) which is wider than said narrower portion (2126);

wherein said conveyance carriage assembly (12) is decelerated when said first arm (2100) and said second arm (2102) slide against said stopping engaging member (232) in said narrower portion (2126); and

said conveyance carriage assembly (12) which has entered said wider portion (2128) after said narrower portion (2126) is spread by said stopping engaging member (232) which presses said first arm (2100) and said second arm (2102), is stopped by said first arm (2100) and said second arm (2102) which engage said stopping engaging member (232).

23. A conveyance system according to claim 22, wherein said first arm (2100) and said second arm (2102) have a support (2130) which supports said stopping engaging member (232).

24. A conveyance system according to claim 22, further comprising:

a second lock mechanism (2108) for positioning and fixing said conveyance carriage assembly (12) which is stopped, said second lock mechanism (2108) having a stopper engaging member

(2152) for engaging a stopper (238) mounted on said conveyance carriage assembly (12).

25. A conveyance system according to claim 22, wherein said stopping engaging member (232) comprises a rotatable cylinder.

26. A conveyance system according to claim 22, wherein said stopping engaging member (232) doubles as a guided member which is guided by a direction changing unit (20) which is interposed between a first conveyance section for conveying said conveyance carriage assembly (12) in one direction and a second conveyance section for conveying said conveyance carriage assembly (12) in a direction different from said one direction.

27. A conveyance system according to claim 26, wherein each of conveyance carriages of said conveyance carriage assembly (12) has two stopping engaging members (232), each of said stopping engaging members (232) doubling as a guided member which is guided by said direction changing unit (20) which interconnects a forward path as said first conveyance section and a return path as said second conveyance section for guiding said conveyance carriage assembly (12) in a direction opposite to said forward path.